

REMARKS

Reconsideration of the present application, as amended, is respectfully requested. Applicants wish to thank the Examiner for the indication of allowability of claim 1 if rewritten or amended to overcome the rejection(s) under 35 U.S.C. §112, second paragraph. Applicants also thank the Examiner for the indication of allowability of claims 2-12 if rewritten to overcome the rejection(s) under 35 U.S.C. §112, second paragraph, and to include the features of the base claim and any intervening claims. Claims 1-12 have been amended to conform to U.S. practice and address the §112 rejections.

A new title has also been added to replace the previous title. In accordance with the Examiner's request, attached as Exhibit 1 is a marked-up copy of a substitute specification and also attached as Exhibit 2 is a clean copy of the substitute specification. Applicants respectfully submit that no new matter has been added by the substitute specification. The specification has been amended to include headings and remove and/or correct various phrases as indicated by the Office Action. Exhibit 2 has been reproduced with double-spacing and on good quality paper as suggested by the Examiner. Applicants also submit a replacement Abstract as requested in the Office Action. As such, Applicants request that the objections to the specification be withdrawn.

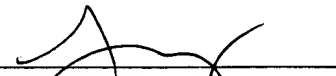
Claims 1-9, 12, and 27 are objected to for various informalities. Regarding claim 27, no such claim exists; therefore, Applicants have disregarded all references to claim 27. Claims 1-9 and 12 have been amended in accordance with U.S. practice and various suggestions by the Examiner. Applicants therefore request that the objections to claims 1-9 and 12 be withdrawn.

Claims 1-12 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Claim 1 has been amended as suggested by the Examiner. Claims 3, 5, and 10 have also been amended in response to the indefiniteness rejection thereof. Applicants respectfully request that the §112 rejection of claims 1-12 be withdrawn.

In view of the above, each of the presently-pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

By 

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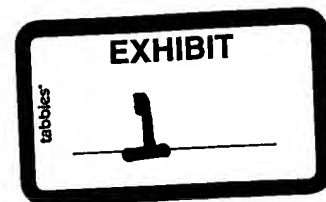
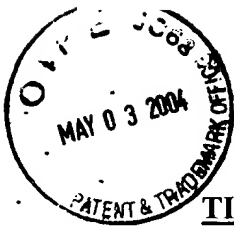
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TITLE OF THE INVENTION

Clock Analog clock with a twenty four hour display

BACKGROUND OF THE INVENTION

Technical Field

The present invention concerns a clock, driven by a mechanical, electrical or electronic motor, with analog and unambiguous 24 hour display ~~in accordance with the preamble to Claim 4.~~

Description of the Related Art

Several clocks with analog and unambiguous 24 hourdisplay are known, for instance from DE 267 810 (D1), US 5,696,740 (D2), WO 91/03774 (D3).

Both in D1 and in D2 the 24 hour unambiguity is obtained by means of two concentric number scales each of 12 hours, where the first 12 hour group comprises the times from 0-12 o'clock, the second the time from 12-24 o'clock. On the transfer from one scale to the other the hour hand always changes its position in an abrupt manner; it either travels outwards or is shortened.

In D3 the unambiguity of the display of the hours is addressed similarly in that two concentric 12-hour scales are arranged on the dial, at the same time however a transparent disc is present which has a period of revolution of 24 hours and - in one embodiment - has two semi-circular shaped covers, which cover the nonapplicable hour values.

Further documents though not under consideration here - (i.e. DE 33 05 414 and DE 40 376 57) show clocks with so-called pseudo-analog presentation, where using electronic auxiliary means, such as LEDs and liquid crystal displays, an unambiguous 24-hour display is, created.

The arrangements published in D1 and D2 for the changing of the length of the hour hand

require either additional energy from the clock motor for tensioning a spring (D1) or an additional source of energy (D2). The solution proposed in D3 shows the hours at all times of the day and night on two semi circles of different radius. Neither in terms of technical producibility nor in market acceptance were these solutions able to succeed.

Although it would be possible with the means described, the transfer from one scale to the other was never chosen to be other than at midday and midnight.

Further, clocks have become known, which have noncircular scales, such as for instance in DE 196 41 885 (D4), DE 299 03 950 (D5) and DE 299 34 451 (D6). Whilst in D4 an hour indicating element is moved on any desired curve as a guiding element, in D5 the indicating element is guided on cycloids, which are generated by a four joint drive, by means of an additional gear wheel, means are described here to move the aforesaid indicating element on non-circular tracks, but a 24-hour indicator of an unambiguous nature is not published therein.

BRIEF SUMMARY OF THE INVENTION

It is therefore the aim of the present invention to move the hour marking indicating element - whether this is the hour hand or a clear and ~~unmistakeable~~ unmistakable element - on a track of this construction, which permits an unambiguous arrangement of the positions of the indicating element during the 24-hour passage of the day and so by its position effects a conspicuous difference between the daytime and night-time hours without the need to alter the customary angular positions of the indicator.

~~The addressing of this aim is given in the characterising part of Claim 1 with regard to its essential features, in the following Claims with regard to further developments of the invention.~~

BRIEF DESCRIPTION OF THE DRAWINGS

The inventive idea is more closely explained using the attached drawing in several

embodiments.

Shown are:

Fig. 1 the plan view of a first embodiment,

Fig. 2 a part of Fig. 1, with a first embodiment of a guide element,

Fig. 3 a longitudinal section through the embodiment in Fig. 1,

Fig. 4 a detail from Fig. 3 with a second embodiment of a guide element,

Fig. 5 a second embodiment in a schematic longitudinal section,

Fig. 6 the embodiment in Fig. 5 in a schematic plan view.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a plan view of a first embodiment of a clock according to the invention. Along with conventional and here adopted elements, such as a minute hand 1, second hand 2, date display 3 and a conventional circular minute scale 4, an hour hand 5 with variable length is shown. The point of the hour hand 5 runs around a ~~two-loop~~ two-loop enclosed curve, such as a first conchoid 7, with an outer loop 8 and an inner loop 9, which have a crossing point 6. The daytime hours from 6 to 18 hours are allocated to the outer loop 8 and the night-time hours from 18 to 6 hours to the inner loop 9. Since these allocations are only of a graphical nature, they can obviously be reversed. On such ~~two-loop~~ two-loop curve is for instance the conchoid, also called the Pascal snail curve, (described, for instance, in Karel Rektorys, applicable Mathematics, Cambridge, Mass., USA 1969). Fig. 1 includes the representation of a second conchoid 10, shown dashed, which is derived by a constant radial offset from the curve 7 with an outer loop 8 and an inner loop 9. This second conchoid 10 is shown dashed because it can be covered by a disc 11; it is formed as a guide curve and together with the guiding elements is more clearly explained in Fig. 2.

Fig. 2 is the representation of only the inventive part of the clock. The disc 11 is shown here only dashed and transparent and allows a clear view of the conchoid 10 lying below and covered by the disc 11. The hour hand 5 is, as was already seen in Fig. 1 constructed from two parts. Its outer part, referenced with the reference 13, is joined in a pivoting manner to a sliding element 12; this sliding element 12 lies in the for instance groove shaped conchoid 10 and follows the track of this conchoid during the circulation of the inner part of the hour hand 5. This inner part of the hour hand 5 carries the reference 14, and is joined' firmly to the disc 11. The disc 11 thus completes a revolution in 12 hours, together with the inner part 14 of the hour hand 5. The sliding element 12 is formed in this embodiment in a sickle shape such that the radius of curvature of the outer-lying surface is smaller than the smallest radius of curvature of the outer surface of the conchoid 10, and that of the inner lying surface is greater than the greatest radius of curvature of the inner surface of the conchoid 10. The longitudinal extension of the sliding element 12 measured in the tangential direction is made large enough so that at the crossing point of the two loops, of the conchoid 10 (which carry the references 15, 16) the sliding element 12 is guided securely from the outer loop 15 to the inner loop 16, or from the inner loop 16 securely onto the outer loop 15.

Fig. 3 is a longitudinal section through the embodiment of Fig. 1 for instance at 24 hours. A dial 24 serves here in the sense of a non-limited example of a mounting platform for all further named and yet to be named elements. This element named below as dial 24 can be attached either to the works, or the case. It is only essential that in the operation of the clock the relationship to the actual dial is fixed. The conchoid 10 with its outer loop 15 and its inner loop 16 is worked into the dial 24 for instance by milling. A hollow shaft, called the hour tube 18, is mounted within the dial 24, with which the disc 11 and the inner part 14 of the hour hand 5 are

joined firmly. For stability reasons the inner part 14 of the hour hand 5 is joined to the disc 11 for instance with a support 19. The disc 11 has a radial slit 20 running parallel to the inner part 14 of the hour hand 5. A guide pin 12, with which the outer part 13 of the hour hand 5 is joined to the sliding element 12, can move in this slit 20. The sliding element 21 is thus moved in an azimuthal direction by the disc 11. The guide pin 21 is for instance firmly fixed to the sliding element 12 and mounted in the outer part 13 of the hour hand 5 so as to pivot about its long axis. In accordance with the invention this can however also be arranged so that the guide pin 21 is firmly fixed to the outer part 13 of the hour hand 5 and mounted on the sliding element 5 so as to pivot about its long axis.

The outer part 13 of the hour hand 5 is arranged so as to be able to slide in the longitudinal direction with respect to its inner part 14, for which arrangement several solutions are known and not to be described here.

The remaining elements, such as the minute tube 22 with the minute hand 1 and the second axle 23 with the second hand 2 are known and only mentioned for completeness. The concept of the dial can be widely interpreted here; the decision as to which and whether figures appear on it is purely of an aesthetic nature. The technical significance of the dial 24 lies in its characteristic as, a baseplate for all the previously mentioned elements in the sense of the previous description.

A section of the conchoid 10 is shown in Fig. 4, together with a further embodiment of sliding element 12 from Fig. 2, 3 named a-guide element 17. This comprises a carrying member 25 and here for instance three wheels 26, 27, 28 rotatably mounted within it. Their arrangement is selected such that the middle wheel 26 lies outside, so that it can touch the outer surface of the conchoid 10; the other two wheels 27, 28 can touch the inner surface of the conchoid 10. The

arrangement of the three wheels 26, 27, 28 is further so designed that the guiding element 17 both in that part of the conchoid 10 with the greatest radius and also that with the smallest it can be moved with radial play in the tangential direction. In the region of the middle wheel 26 the carrying member 25 carries the guide pin 21, for which the same applies as previously stated under Fig. 3.

Also included in Fig. 4, however dotted, is a modification of the carrying member 25. One arm 29 of the carrying member 25 is constructed as a flexing spring 30, so that all three wheels 26, 27, 28 can always touch the side surfaces of the conchoid 10 assigned to them. Alternatively both arms of the carrying member 25 can be constructed as flexing springs 30, whereby the applied pressure of the wheels 26, 27, 28 onto the side surfaces can be better apportioned.

The length of the guiding element 17, that is the separation of the wheels 27, 28 is chosen such that the crossing point of the two loops 15, 16 of the conchoid 10 can be passed in the correct sense. The number of wheels 26, 27, 28 can obviously be chosen to be different, for instance larger, with a corresponding adaptation of the form and construction of the carrying member 25.

Figures 5 and 6 are representations of a second embodiment for the guidance of the point of the hour hand 5 onto the ~~two-loop~~ two-loop curve 7 provided. Fig. 5 is a section perpendicular to the plane of the dial 24, Fig. 6 a plan view. For a better understanding, Fig. 5 is produced so that all the sequential axes lie in the same plane, which actually is never; the case.

In Fig. 6 a two-loop curve (also called a Pascal snail) 31 is shown dashed, with an outer loop 40 and an inner loop 41 and a crossing point 42. This corresponds functionally to the conchoid 10 from Fig. 2 and also in so far as it at least indicates the track of the guide pin 21 in

so far as that obviously a radial offset: by a constant, or also by a variable amount - for instance proportional - is included within the inventive idea. This curve 31 is generated in this embodiment by the interworking of several gear wheels and guide arms, as set out below:

Firmly fixed to the dial 24 - or the assembly platform corresponding to it - is a gear wheel A with radius $r(A)$, coaxial with the hour tube 18. The hour tube 18 carries an arm 32, circulating with it, in which an axle 36 of a second gear wheel B with radius $r(B)$ is mounted, whereby:

$$r(B) = 2r(A) \quad \text{equation (1)}$$

Further these radii and the crossing point 42 of the two loops 40, 41 of the curve 31 - whose distance from the centre of the hour tube is designated $d(31)$ - are connected such that

$$r(A) + r(B) = d(31) \quad \text{equation (2)}$$

The arm 32 can be a flat-formed component in a plane parallel to that of the gear wheels. It carries here, firmly fixed to it, a third gear wheel C with radius $r(C)$, which meshes with a fourth gear wheel D1 with radius $r(D1)$, which is mounted on an axle 33. This is mounted in a second arm 34. The second arm 34 sits firmly on the axle 36 of the second gear wheel B and therefore runs around with this. The axle 33 of the fourth gear wheel D1 carries - similarly joined firmly to it - a fifth gear wheel D2 with radius $r(D2)$ which meshes with a sixth gear wheel E with radius $r(E)$. This sixth gear wheel E is mounted on an axle 35, which is fastened on the second arm 34 at a distance $d(E)$ from the axle 36 and runs parallel to all the previously mentioned axles. The sixth gear wheel E carries at a distance $d(F)$ from the axle 35 the guide pin 21 running parallel to the axles 33, 36.

The following equations apply for the further named radii and distances:

$$r(D1) = 1/2r(C) \quad \text{equation (3)}$$

$$r(E) = r(D2) \quad \text{equation (4)}$$

$$d(E) = d(F) \quad \text{equation (5)}$$

Whilst the crossing point 42 of the two loops 40, 41 is fixed by equation (2), the two loops 40, 41 themselves are only defined by the equations (3), (4), (5) and (6):

$$d(40) - d(41) = 4d(E) \quad \text{equation (6)}$$

The choice of $r(C)$ is not dependent on $r(A)$, but purely opportunistically based on the available space, with the limitation that - if the hour tube 18 is given the radius $r(18)$ -

$$R(C) < r(A) + r(B - r(18)) \quad \text{equation (7) ;}$$

The disc 11 and the outer and inner parts 13, 14 of the hour hand 5 are, not shown in Fig. 5, 6. All these elements can be arranged as shown in the first embodiment.

As a modification to this the actual dial 24 can be made at least partly transparent and arranged such that the minute and second hands 1, 2 run above it, the hour display, however, below it. Instead of the guide pin 21 the gear wheel E then bears an especially prominent marking, owing to its brightness or colour - for instance a round small disc - which runs around the-two-loop curve 31. This small disc then replaces the point of the hour hand 5. The latter and also the aforesaid small disc are then indicating elements.

For the gearing specialist other arrangements of gear wheels and possibly the arms carrying them, can be realised and are included in the inventive idea, which fulfil the aim of generating the desired conchoid as a track for the indicating, element, using a guide pin 21 or a corresponding component.

Claims

1. A clock, with a mechanical, electrical or electronic motor, with analog and unambiguous 24 hour display, with at least one indicating element for the hours, which is driven by an hour tube (18), characterised in that
 - the indicating element (5) for the hours runs around a two-loop closed curve (7, 31), called a conchoid or Pascal snail, of which each point is touched exactly once in 24 hours by the indicating element (5), whereby the said curve (7, 31) has an outer loop (8, 40) and an inner loop ((9,41) with a crossing point (42) of the two loops (8, 40; 9, 41),
 - means are present to guide the indicating element (5) along the said two loop curve (7, 31),
 - the angular position of the indicating element (5) with regard to the null points of time at 12 h and 24 h is that as in known clocks.
2. A-clock according to Claim 1, characterised in that the means by which the, indicating element is guided along the said two loop curve (7, 31) comprise the following elements,
 - a groove, at least indirectly connected to the dial (24), which is also formed as a two loop closed curve in the shape of a conchoid (10),
 - a guiding element (12, 17), which can move along in the said conchoid (10) and carries a guide pin (21)
 - an element (11, 14) firmly fixed to the hour tube (18), which moves the guiding element (12, 17) in the conchoid (10) at, least indirectly,
 - an indicating element (13), which is moved in a radial direction by the guide pin (21), and in the azimuthal direction by the element (11, 14) firmly fixed to the

hour tube (18).

3. A clock according to Claim 2, characterised in that
 - a variable length hour hand (5) is present with an inner part (14) and an outer part (13), whereby the inner part (14) can be joined to the element firmly joined to the hour tube (18),
 - the outer part (13) of the hour hand (5) can be slid in a radial direction relative to the inner part (14) and is moved by it in an azimuthal direction,
 - the radial movement of the outer part (13) of the hour hand (5) is caused by the guide pin (21), which is at least indirectly in connection with the said outer part (13),
 - the indicating element is the point of the outer part (13) of the hour hand (5).
4. A clock according to Claim 3, characterised in that the guiding element, which carries the guide pin (21), is a sickle shaped sliding element (12), which can move azimuthally with radial play in the groove formed conchoid (10), whereby outer radius of curvature of the sickle shaped sliding element (12) is smaller than the smallest radius of curvature of the outer surface of the groove-shaped conchoid (10), and the inner radius of curvature of the sickle shaped sliding element (12) is greater than the greatest radius of curvature of the inner surface of the groove-shaped conchoid (10).
5. A clock according to Claim 3, characterised in that
 - the guiding element, which carries the guide pin (21) is a guiding element (17) with at least three wheels (26, 27, 28) with parallel axles perpendicular to the plane of the dial (24), with two arms (29), further a carrying member (25) is present, in which the three said wheels (26, 27, 28) are mounted, whereby each of

- the two arms (29) carries one wheel (26, 28), and the third wheel (27) is mounted between the two wheels (26, 28) in the carrying member (25),
- the wheels (26, 27, 28) are arranged behind one another in the direction of the track of the conchoid (10), so that the first and the third wheel (26, 28) can touch the inner surface of the conchoid (10) and the centre wheel (27) the outer surface of the conchoid (10),
 - the three wheels aforesaid are further arranged so that both at the position in the conchoid (10) with the greatest, and also in that with the smallest radius of curvature, sufficient radial play is available so as to facilitate easy aximuthal movement of the guiding element (17),
 - the guide pin (21) is arranged in the region of the centre wheel (27).
6. A clock according to Claim 5, characterised in that of the arms (29) between the centre wheel (27) and the outer wheels (26, 28) at least one is produced as a flexing spring (30) working in a radial direction.
7. A clock according to Claim 1, characterised in that the means for guiding the indicating element on the said two loop curve (7, 31), comprise gear wheels and the arms necessary to carry them.
8. A clock according to Claim 7, characterised in that
- the means for guiding the indicating element on the said two loop curve (7, 31), comprise the following elements,
 - a first gear wheel (A), with radius $r(A)$, which is arranged concentrically with the hour tube (18) with radius $r(18)$ and is firmly connected at least indirectly to the dial (24),

- a first arm (32) firmly connected to the hour tube (18) and extending outwards, in which a first axle (36) of a second gear wheel (B) with radius $r(B)$ is rotatably mounted,
- the second gear wheel (B) lies in the same plane as the first gear wheel (A) and meshes with it,
- a third gear wheel (C) with radius $r(C)$ is present and arranged concentrically with the second gear wheel (B) and is firmly connected to the first arm (32), a second arm (34) is present and similarly fastened to the second gear wheel (B) on the same axle,
- a fourth gear wheel with radius $r(D1)$ is present, which lies in the same plane as the third gear wheel (C) and meshes with it,
- the fourth gear wheel (D1) is fastened on an axle (33) running parallel to the axle (36), which is mounted rotatably in the second arm (34),
- the second arm (34) carries an axle (35) at a distance $d(E)$ from the axle (36), to which it is fastened, running parallel to it
- a fifth gear wheel (E) is present, which can rotate about the last named axle (35) and at a distance $d(F)$ from this carries the guide pin (21) arranged parallel to it,
- a sixth gear wheel (D2) with radius $r(D2)$ is present, which is arranged in the same plane as the fifth gear wheel (E) and meshes with it, whereby the sixth gear wheel (D2) is fastened on the same axle (33) as the fourth gear wheel (D1), coaxial with it,
- the following relationships apply for the radii $r(A)$, $r(B)$, $r(c)$, $r(D1)$, $r(D2)$:

$$r(B) = 2r(A)$$

$$r(C) = 2r(D1)$$

$$r(E) = r(D2).$$

9. A clock according to Claim 8, characterised in that

- the crossing point (42) of the two loops (40, 41) of the two loop curve (31) has a distance d(31) from the centre of the hour tube (18) whereby

$$r(A) + r(B) = d(31)$$

applies,

- the greatest radial distance of each of the two loops (40, 41) of the two loop curve (31) amounts to d(40) or d(41) and is connected to the distances d(E) and d(F) in accordance with the following equations:

$$d(E) = d(F)$$

$$d(40) = d(41) = 4d(E),$$

- the hour tube (18) has an outer radius r(18), which together with r(A), r(B), and r(C) define the limitation that

$$r(C) \leq r(A) + r(B) - r(18).$$

10. A clock according to Claim 3 and Claim 7, characterised in that

- the element firmly joined to the hour tube (18) is a disc (11) arranged, concentrically to it,
- a variable length hour hand (5) is present with an inner part (14) and an outer part (13), whereby the inner part (14) can be joined to, the disc (11),

Abstract

The clock according to the invention has, as well as known elements, such as a minute hand (1), a second hand (2), a minute scale (4) and date display (3), an hour scale on a two loop curve (Pascal snail) (7) with an outer loop (8) for the hours of the day from 6 - 18 hours and the night-time hours from 18 - 6 hours, with a crossing point (6) of the two loops (8, 9) at 6/18 hours. To achieve unambiguous indication the hour hand (5) is made variable in length. In a second such curve (10) offset by a constant amount radially inwards with respect to the first curve (7), which for instance is milled in the form of a groove in the dial, a guiding element is moved azimuthally through the inner part of the hour hand (5), which receives an overlay of radial movement owing to the shape of the second curve (10). The second curve (10) with the guiding element is covered by a disc (11) joined to the inner part of the hour hand (5) and turning with it.

(Fig. 1)